

FIG. 1

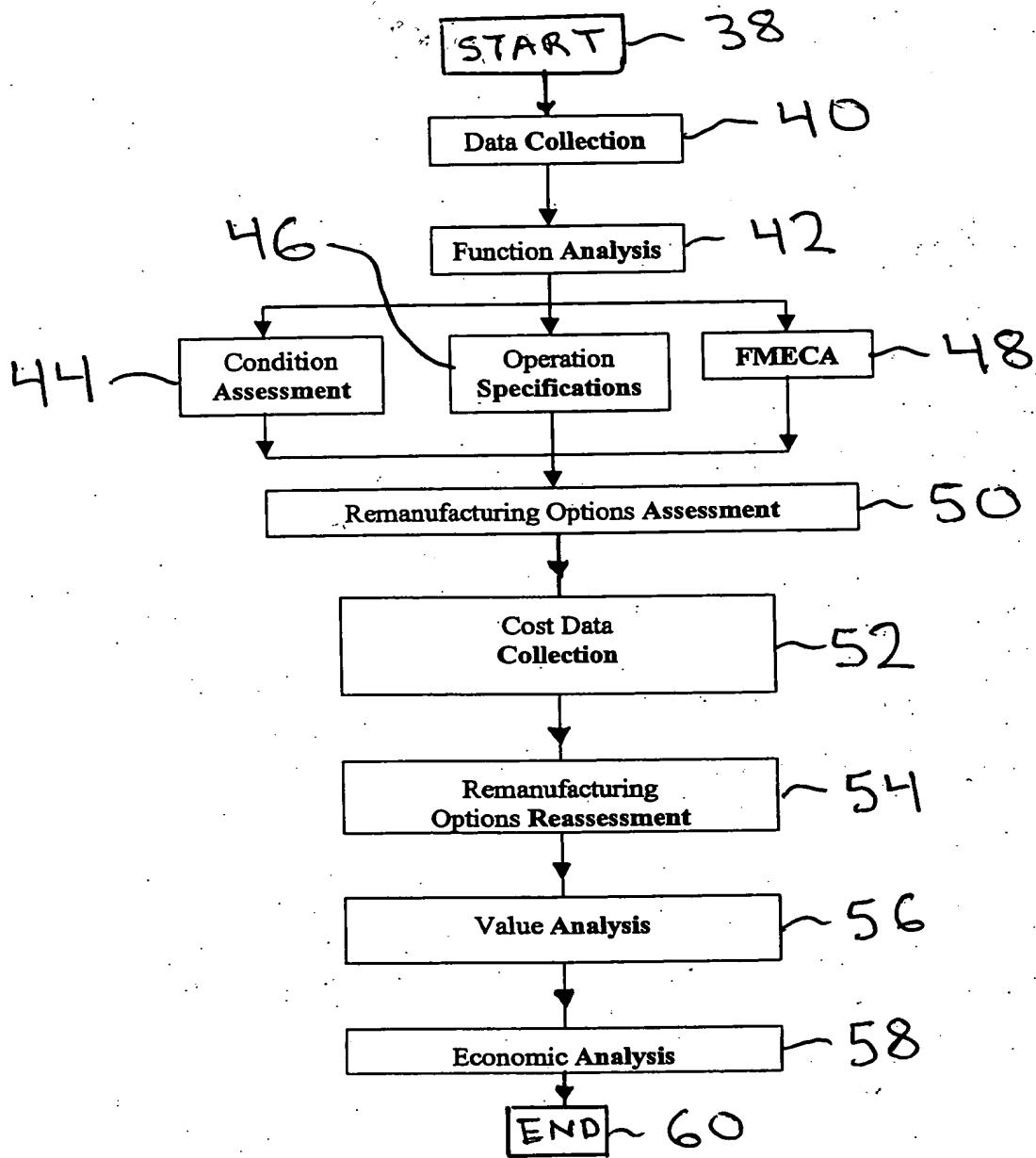


FIG. 2

Data Availability Matrix

System Hierarchy		Failure Log	Manuals	System Map/Drawings	Function Definition	Open Specs	Customer Specs	Technology Upgrade	Condition Assessment	New Cogn (S)	Data Missing (Count)	Percent of data
		1	2	3	4	5	6	7	8	9	10	11
MECHANICAL											1017	52%
Propulsion											166	38%
Drive MTU (port)												
Mounting	x	x	x	●	x	x	x	●	▲			
Remote control from the bridge		●	●	x				●	▲			
Enclosed operator space controls		●	●	x				●	▲			
Local controls		●	●	x				●	▲			
Exhaust	x	x	●	x				●	▲			
Ignition			x	●					▲			
Air intake	x	x	●	x				●	▲			
Reduction gearing			x	●	●			●	▲			
Water seal	x	x	●	x				●	▲			
Drive shaft	x	x	●	x				●	▲			
Turbocharger				x				●	▲			
Salt water cooling	x			x				●	▲			
Fuel oil system	x			x				●	▲			
Engine coolant pre-heater	●	x	●	x				●	▲			
Drive MTU internal air compressor				x				●	▲			
Hydraulics					x			●	▲			
Engine block components	x			x				●	▲			
Drive MTU (starboard)												
Mounting	x	x	x	●	x	x	x	●	▲			
Remote control from the bridge		●	●	x				●	▲			
Enclosed operator space controls		●	●	x				●	▲			
Local controls		●	●	x				●	▲			
Exhaust	x	x	●	x				●	▲			
Ignition			x	●					▲			
Air intake	x	x	●	x				●	▲			
Reduction gearing		x	●	●	x			●	▲			
Water seal	x	x	●	x				●	▲			
Drive shaft	x	x	●	x				●	▲			
Turbocharger				x				●	▲			
Salt water cooling	x			x				●	▲			
Fuel oil system	x			x				●	▲			
Engine coolant pre-heater	●	x	●	x				●	▲			
Drive MTU internal air compressor				x				●	▲			
Hydraulics					x			●	▲			
Engine block components	x			x				●	▲			
KaMeWa jet (port)												
Hydraulic powerpack				●				●	▲			
Hydraulic lines	x		●	●				●	▲			
Electric heater	x	x	●	●				●	▲			
Jet nozzle	●	●	●	●				●	▲			
Jet pump	●	●	●	●				●	▲			
KaMeWa jet (starboard)												
Hydraulic powerpack				●				●	▲			
Hydraulic lines	x		●	●				●	▲			

FIG. 3

SES-200

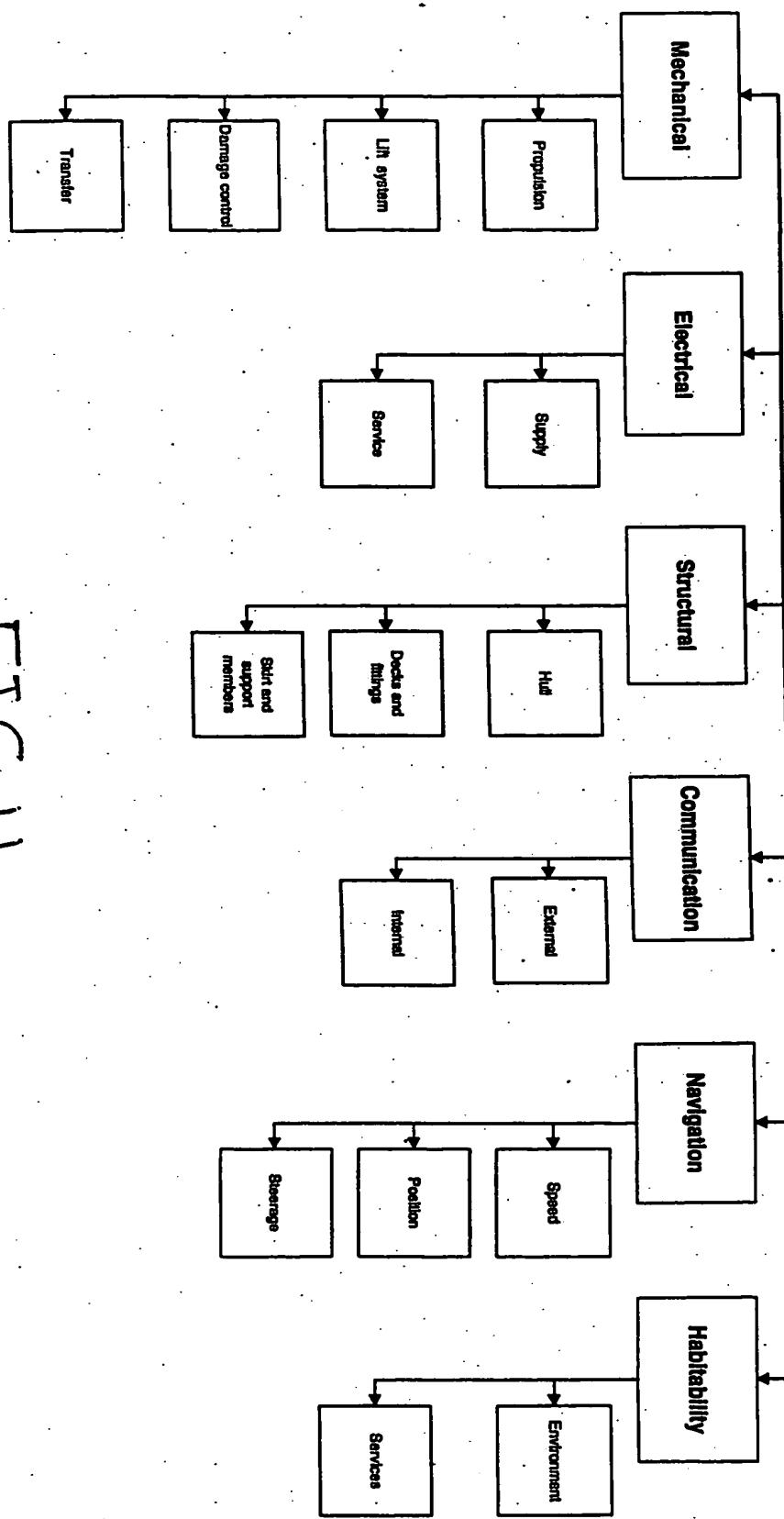


FIG. 4

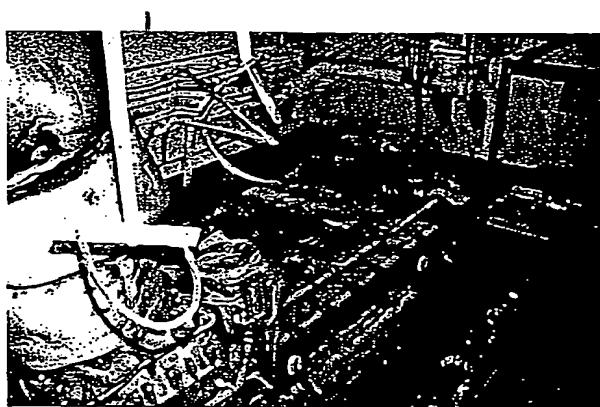
Function Matrix

System	Subsystem	Element	Primary Function	Secondary function
MECHANICAL				
Propulsion	Drive MTU [cont]		Deliver torque to port KameWa waterjet pump	
	Mounting		Secure engine to ship frame to prevent movement and vibration	
	Remote control from the bridge		Provide means to control engine for navigation purposes	
	Enclosed operator spaces controls		Provide for centralized monitoring and control of engines	
	Local controls		Provide local control of engine functions	
	Exhaust		Expel combustion gasses to exterior of ship	
	Intake		Provide means for engine start-up	
	Air intake		Transfer air to engine for combustion	
	Refrigeration cooling		Reduce RPM to KAW jets to prevent cavitation	
	Water seal		Provides seal between drive shaft and bushing	Interface with sea water cooling transfer system
	Drive shaft		Transfer power from engine to KameWa waterjet pump (front)	Interface with sea oil transfer system
	Turbocharger		Provide cooling to engine, exhaust and induction gearing	
	Sea water cooling		Provide cooling to engine, exhaust and induction gearing	
	Fuel oil system		Heat engine coolant during extreme weather to prevent freezing	
	Engine cooled oil-bath bearing		Provide fuel oil to engine	
	Drive MTU internal air compressor		Provide compressed air for engine functions	
	Hydraulics		Provide hydraulic pressure boost for KameWa hydraulic pack	
	Engine block components		Convert chemical energy (fuel oil) to mechanical energy	
Driveline/Steering				
Drive MTU [Steering]	Mounting		Deliver torque to standard KameWa waterjet pump	
	Remote control from the bridge		Secure engine to ship frame to prevent movement and vibration	
	Enclosed operator spaces controls		Provide means to control engine for navigation purposes	
	Local controls		Provide local control of engine functions	
	Exhaust		Expel combustion gasses to exterior of ship	
	Intake		Provide means for engine start-up	
	Air intake		Reduce RPM to KAW jets to prevent cavitation	
	Refrigeration cooling		Provides seal between drive shaft and bushing	Interface with sea water cooling transfer system
	Water seal		Transfer power from engine to KameWa waterjet pump (starboard)	Interface with sea oil transfer system
	Drive shaft		Provide cooling to engine, exhaust and induction gearing	
	Turbocharger		Provide cooling to engine, exhaust and induction gearing	
	Sea water cooling		Heat engine coolant during extreme weather to prevent freezing	
	Fuel oil system		Provide fuel oil to engine	
	Drive MTU internal air compressor		Provide hydraulic pressure for engine functions	
	Hydraulics		Conver chemical energy (fuel oil) to mechanical energy	
	Engine block components		Conver torque supplied by port drive engine to propulsory force	
KameWa jet [cont]				
	Hydraulic powerpack		Provide hydraulic pressure for waterjet propulsory force	
	Hydraulic lines		Transfer hydraulic pressure from powerpack to waterjet	
	Electric heater		Maintain ambient temperature around jets	
	Jet nozzle		Provide means of direction水流 for steering/turning	
	Jet pump		Output seawater under pressure to provide propulsory force	
KameWa jet [standard]				
	Hydraulic powerpack		Provide hydraulic pressure for waterjet propulsory force	
	Hydraulic lines		Transfer hydraulic pressure from powerpack to waterjet	
	Electric heater		Maintain ambient temperature around jets	
	Jet nozzle		Provide means of direction水流 for steering/turning	
	Jet pump		Output seawater under pressure to provide propulsory force	

FIG. 5

Condition Assessment Data Sheet

ESWBS:
23310
Function Group:
MECHANICAL
System:
Propulsion
Sub-system:
Drive MTU
Item description:
Drive MTU port



Frame location:		Ship location:	
8-6 to 8-10		(11) Port	
Manufacturer:	Model #:	Part #:	Serial #:
MTU	MTU 16V-396 TB94	N/A	559-0477
Condition:			
Mounting, Remote control from the bridge, Enclosed operator space controls, Local controls, Exhaust, Ignition, Air intake, Reduction gearing, Water seal, Drive shaft, Turbocharger, Salt water cooling, Fuel oil system, Engine coolant pre-heater, Aux drive MTU air compressor, Hydraulics, Engine block components, *Operating hours meter = 1930.68 hrs *Turbo rusted *Slight corrosion or other surface damage *Air intakes missing *Water buildup in drive shaft compartment *Coolant manifold severely cracked * Large coupling on drive shaft (FR 13) corroded *Wt. = 6685 kg *2560 kW *2150 RPM *Sea water cooling fitting to reduction gear cracked *See detailed report from Florida Detroit Diesel-MTU for more information			

FIG. 6

Condition Assessment Matrix

System Hierarchy		Physical Condition	Overall Condition		
			Good	Fair	Poor
MECHANICAL	Propulsion	Ruptured	●	●	●
	Drive MTU (port)	Cracked	●	●	●
	Mounting	Fractured/	●	●	●
	Remote control from the bridge	Connected	●	●	●
	Enclosed operator space controls	Dis-	●	●	●
	Local controls	Misaligned	●	●	●
	Exhaust	Parts	●	●	●
	Ignition	Seepage	●	●	●
	Air intake	Water	●	●	●
	Reduction gearing	Leakage	●	●	●
	Water seal	Fuel	●	●	●
	Drive shaft	Leakage	●	●	●
	Turbocharger	Oil	●	●	●
	Salt water cooling	Excessive wear	●	●	●
	Fuel oil system	Severe corrosion	●	●	●
	Engine coolant pre-heater	Light corrosion	●	●	●
	Drive MTU internal air compressor	Seized/	●	●	●
	Hydraulics	frozen	●	●	●
	Engine block components	Seized/	●	●	●
	Drive MTU (starboard)	frozen	●	●	●
	Mounting	Seized/	●	●	●
	Remote control from the bridge	frozen	●	●	●
	Enclosed operator space controls	Seized/	●	●	●
	Local controls	frozen	●	●	●
	Exhaust	Seized/	●	●	●
	Ignition	frozen	●	●	●
	Air intake	Seized/	●	●	●
	Reduction gearing	frozen	●	●	●
	Water seal	Seized/	●	●	●
	Drive shaft	frozen	●	●	●

FIG. 7

Operation Specification Matrix

System	Subsystem	Element	Operational Specification
MECHANICAL	Propulsion	Drive MTU (port)	MTU 16V386TB94, Liquid cooled, Four-stroke diesel engine, Anti-clockwise direction of rotation, High Performance Rating Class 1D9- Fast Vessel, Certification w/desastable power (0.869 x rated power) from all leading classification societies, Fuel Power Stop kW (mph): 2560 (3482) Engine output: 3200 bhp each, Speed RPM: 2150, Gearbox Model: BW 755 Free-standing, Transmission Ratio: 2.33 : 1, Bore/Stroke mm (in.): 165/185 (6.57/7.3), Total Displacement L (in ³): 63.4 (3866), Intake air temp. 25°C / Sea water temp. 25°C, 3.0% power reduction @ 45°C (alt) / 32°C (water), 6635 kg weight
		Mounting	Flanges and central rubber elements
MECHANICAL	Control	Remote control from the bridge	
		Enclosed operator space controls	Sheet-steel housing w/resilient mounts
MECHANICAL	Local controls		Speed, Temperatures (coolant, raw water, charge air, exhaust before turbine), Pressure (block, non-return valves, coolant & raw water lines), Fluid levels
		Exhaust	Exhaust gas turbo-charging
MECHANICAL	Ignition		Electric starter
		Air intake	Combustion air system, Intake filter strainer w/attaching hardware
MECHANICAL	Reduction gearing		Valve gear and gear train, Baehr BW755, Sinter #219 (STREB) #220 (PORT), Ratio 2.33 : 1

FIG. 8

Failure Modes, Effects, and Criticality Analysis (FMECA)

System	Subsystem	Function	Failure Modes	Cause
Drive MTU	Drive MTU	Deliver torque to KaMeWa waterjet pump		
		Secure engine to ship framing to prevent movement and vibration	Mounting fails	Wear
				Corrosion
				Manufacturer's defect
		Provide means to control engine from bridge for navigation purposes	Remote control from the bridge fails	Power Failure
				Circuit Interruption
		Provide for centralized monitoring and control of engines	Enclosed operator space controls fail	Power Failure
				Circuit Interruption
		Provide local control of engine functions	Local controls fail	Power Failure
				Circuit Interruption
		Expel combustion gases to exterior of ship	Exhaust fails	Obstruction
				Faulty Seal
				Damaged Piping
		Provide means for engine start-up	Ignition fails	Air System Failure
				Power Failure
				Circuit Interruption
		Transfer air to engine for combustion	Air intake fails	Obstruction
		Reduce RPMs to KMW jets to prevent cavitation	Reduction gear fails	Wear
				Corrosion
				Insufficient Lubrication
				Manufacturer's defect
		Transfer power from engine to KaMeWa waterjet pump (port)	Drive shaft fails	Wear
				Corrosion
				Load
				Manufacturer's defect
Provides seal between drive shaft and bulkhead	Water/ Seal leaks	Wear		
		Manufacturer's defect		
Boost engine power	Turbocharger fails	Wear		
		Corrosion		
		Manufacturer's defect		
Provide cooling to engine, exhaust and reduction gearing	Salt water cooling fails	Wear		
		Corrosion		
		Manufacturer's defect		
Heat engine coolant during extreme weather to prevent freezing	Kim HotStart Engine Coolant Heater fails	Power Failure		
		Electrical grounding		

FIG. 9A

Failure Modes, Effects, and Criticality Analysis (FMECA)

Local Effect	Secondary Effect	Ultimate Effect	Detection	Sev.	Freq.	RPN
Excessive engine vibration/movement	Engine failure/drive train damage	Compromised propulsion to ship	Audible	7	3	21
Excessive engine vibration/movement	Engine failure/drive train damage	Compromised propulsion to ship	Audible	7	3	21
Excessive engine vibration/movement	Engine failure/drive train damage	Compromised propulsion to ship	Audible	7	2	14
Loss of engine control from bridge		Inability to remotely control engines	Operational Failure	4	3	12
Loss of engine control from bridge		Inability to remotely control engines	Operational Failure	4	5	20
System fails to respond to controls from ECR	Loss of remote control of engine (from bridge)	Compromised propulsion to ship	Operational Failure	6	3	18
System fails to respond to controls from ECR	Loss of remote control of engine (from bridge)	Compromised propulsion to ship	Operational Failure	6	3	18
Total loss of engine control	Runaway engine	Catastrophic damage to engine/potential loss of life	Audible	9	1	9
Total loss of engine control	Runaway engine	Catastrophic damage to engine/potential loss of life	Audible	9	1	9
Excessive backpressure	Stall engine	Compromised propulsion to ship	Gaging	6	1	6
Exhaust blow-by	Air quality in ship compromised	Health hazard	Gaging/Visual	9	4	36
Exhaust blow-by	Air quality in ship compromised	Health hazard	Gaging/Visual	9	4	36
Engine will not start		Compromised propulsion to ship	Operational Failure	7	4	28
Engine will not start		Compromised propulsion to ship	Operational Failure	7	4	28
Engine will not start		Compromised propulsion to ship	Operational Failure	7	4	28
Reduced airflow to engine	Improper combustion	Compromised propulsion to ship	Gaging	4	2	8
Gearbox/drive shaft damage	No power transmission to KaMeWa	Compromised propulsion to ship	Visual	6	4	24
Gearbox/drive shaft damage	No power transmission to KaMeWa	Compromised propulsion to ship	Visual	6	4	24
Gearbox/drive shaft damage	No power transmission to KaMeWa	Compromised propulsion to ship	Visual	6	2	12
Bent/broken drive shaft	No power transmission to KaMeWa	Compromised propulsion to ship	Visual	6	4	24
Bent/broken drive shaft	No power transmission to KaMeWa	Compromised propulsion to ship	Visual	6	4	24
Bent/broken drive shaft	No power transmission to KaMeWa	Compromised propulsion to ship	Visual	6	2	12
Seawater leakage	Ship's trim affected	Below deck water/flooding	Visual	7	4	28
Seawater leakage	Ship's trim affected	Below deck water/flooding	Visual	7	2	14
No boost	Decreased engine output	Reduction in engine efficiency	Gaging	3	4	12
No boost	Decreased engine output	Reduction in engine efficiency	Gaging	3	5	15
No boost	Decreased engine output	Reduction in engine efficiency	Gaging	3	2	6
Engine/Gearbox/Exhaust Overheats	Engine failure	Compromised propulsion to ship	Gaging	6	2	12
Engine/Gearbox/Exhaust Overheats	Engine failure	Compromised propulsion to ship	Gaging	6	3	18
Engine/Gearbox/Exhaust Overheats	Engine failure	Compromised propulsion to ship	Gaging	6	2	12
Inability to preheat coolant at start-up	Potential thermal stressing	Engine failure/thermal cracking of engine block	Gaging	7	3	21
Inability to preheat coolant at start-up	Potential thermal stressing	Engine failure/thermal cracking of engine block	Gaging	7	3	21

FIG. 9B

Remanufacturing Options Criteria

FIG. 10

Remanufacturing Options Matrix

Legend:

Identifies option as a "best" possible choice in the remanufacturing process

Identifies option as a possible choice in the remanufacturing process

Identifies option as not feasible in the remanufacturing process

System	Sub-System	Element	Modify	Restore	Reuse	Replace	Remove
Propulsion							
Drive MTU (port)							
Mounting							
Remote control from the bridge							
Enclosed operator space controls							
Local controls							
Exhaust							
Ignition							
Air intake							
Reduction gearing							
Water seal							
Drive shaft							
Turbocharger							
Salt water cooling							
Fuel oil system							
Engine coolant pre-heater							
Drive MTU internal air compressor							
Hydraulics							
Engine block components							
Drive MTU (starboard)							
Mounting							
Remote control from the bridge							
Enclosed operator space controls							
Local controls							
Exhaust							
Ignition							

FIG. 11

SES Conversion Project InfoBase - [SES Conversion Project InfoBase]

File | Edit | View | Insert | Tools | Window | Help

Report Administration

SES 200

MECHANICAL

Propulsion

- S Main engine #2 (port)
- S Remote control
- S Enclosed open
- S Local controls
- S Exhaust
- S Ignition
- S Air intake
- S Turbocharger
- S Salt water cooler
- S Fuel oil system
- S Engine coolant
- S Internal air cooler
- S Engine block cooling
- S Main engine #1 (starboard)
- S Remote control
- S Enclosed open
- S Local controls
- S Exhaust
- S Ignition
- S Air intake
- S Turbocharger
- S Salt water cooler
- S Fuel oil system
- S Engine coolant
- S Internal air cooler
- S Engine block cooling
- S KakaWa jet (port)
- S KakaWa jet (starboard)
- S Reduction Gears (port)
- S Water seal (port)
- S Driveshaft (port)

Main engine #2 (port)

ID: 1405 | Technical | Feasibility

Remain Cost | Calculations | Summary | Final | Notes

Equipment

Manufacturer: MTU | Part Number: 16V-396-TFB41 | Human Durability:

Model: 16V-396-TFB41 | Serial Number: 559-0477

Option	Technical	Economic	Notes	Ref
Modify	Impractical	Impractical		
Remove	Impractical	Impractical		1
Replace	Possible	Possible		2
Restore	Best	Best		
Reuse	Impractical	Impractical		

Quantity: 1 (all prices are based on quantity one)

Repair Options

Company Name: MTU Friedrichshafen w/ DCI | Contact Name: Phil Wessinger

Replace

Address1: 1401 H Street, N.W., Suite 700 | Preferred By:

Option Cost: \$647,000.00 | Phone Number: +1-202-414-6778

Installation Cost: \$5,000.00 | Fax Number: +1-202-414-6773

Shipping Cost: \$0.00 | Email: phil_wessinger@california.com

Uninstall Cost: \$5,000.00

Salvage Value: \$150,000.00

Quote Type: OEM

Replacement Part# | Source Reference | Request for Quotation

Other Information: Responsible: SGO | Quotation ID: []

The price quote is per engine and includes controls, monitoring systems and engine coolant pre-heater (\$607,000). Remove the current air inlet housing and move to side of hull or area behind the pilot house (\$40,000).

Record: 14 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 | 560 | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 | 577 | 578 | 579 | 580 | 581 | 582 | 583 | 584 | 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 | 617 | 618 | 619 | 620 | 621 | 622 | 623 | 624 | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 | 641 | 642 | 643 | 644 | 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 | 698 | 699 | 700 | 701 | 702 | 703 | 704 | 705 | 706 | 707 | 708 | 709 | 710 | 711 | 712 | 713 | 714 | 715 | 716 | 717 | 718 | 719 | 720 | 721 | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 | 734 | 735 | 736 | 737 | 738 | 739 | 740 | 741 | 742 | 743 | 744 | 745 | 746 | 747 | 748 | 749 | 750 | 751 | 752 | 753 | 754 | 755 | 756 | 757 | 758 | 759 | 760 | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769 | 770 | 771 | 772 | 773 | 774 | 775 | 776 | 777 | 778 | 779 | 780 | 781 | 782 | 783 | 784 | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 | 796 | 797 | 798 | 799 | 800 | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810 | 811 | 812 | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821 | 822 | 823 | 824 | 825 | 826 | 827 | 828 | 829 | 830 | 831 | 832 | 833 | 834 | 835 | 836 | 837 | 838 | 839 | 840 | 841 | 842 | 843 | 844 | 845 | 846 | 847 | 848 | 849 | 850 | 851 | 852 | 853 | 854 | 855 | 856 | 857 | 858 | 859 | 860 | 861 | 862 | 863 | 864 | 865 | 866 | 867 | 868 | 869 | 870 | 871 | 872 | 873 | 874 | 875 | 876 | 877 | 878 | 879 | 880 | 881 | 882 | 883 | 884 | 885 | 886 | 887 | 888 | 889 | 890 | 891 | 892 | 893 | 894 | 895 | 896 | 897 | 898 | 899 | 900 | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 | 909 | 910 | 911 | 912 | 913 | 914 | 915 | 916 | 917 | 918 | 919 | 920 | 921 | 922 | 923 | 924 | 925 | 926 | 927 | 928 | 929 | 930 | 931 | 932 | 933 | 934 | 935 | 936 | 937 | 938 | 939 | 940 | 941 | 942 | 943 | 944 | 945 | 946 | 947 | 948 | 949 | 950 | 951 | 952 | 953 | 954 | 955 | 956 | 957 | 958 | 959 | 960 | 961 | 962 | 963 | 964 | 965 | 966 | 967 | 968 | 969 | 970 | 971 | 972 | 973 | 974 | 975 | 976 | 977 | 978 | 979 | 980 | 981 | 982 | 983 | 984 | 985 | 986 | 987 | 988 | 989 | 990 | 991 | 992 | 993 | 994 | 995 | 996 | 997 | 998 | 999 | 1000 | 1001 | 1002 | 1003 | 1004 | 1005 | 1006 | 1007 | 1008 | 1009 | 10010 | 10011 | 10012 | 10013 | 10014 | 10015 | 10016 | 10017 | 10018 | 10019 | 10020 | 10021 | 10022 | 10023 | 10024 | 10025 | 10026 | 10027 | 10028 | 10029 | 10030 | 10031 | 10032 | 10033 | 10034 | 10035 | 10036 | 10037 | 10038 | 10039 | 10040 | 10041 | 10042 | 10043 | 10044 | 10045 | 10046 | 10047 | 10048 | 10049 | 10050 | 10051 | 10052 | 10053 | 10054 | 10055 | 10056 | 10057 | 10058 | 10059 | 10060 | 10061 | 10062 | 10063 | 10064 | 10065 | 10066 | 10067 | 10068 | 10069 | 10070 | 10071 | 10072 | 10073 | 10074 | 10075 | 10076 | 10077 | 10078 | 10079 | 10080 | 10081 | 10082 | 10083 | 10084 | 10085 | 10086 | 10087 | 10088 | 10089 | 10090 | 10091 | 10092 | 10093 | 10094 | 10095 | 10096 | 10097 | 10098 | 10099 | 100100 | 100101 | 100102 | 100103 | 100104 | 100105 | 100106 | 100107 | 100108 | 100109 | 100110 | 100111 | 100112 | 100113 | 100114 | 100115 | 100116 | 100117 | 100118 | 100119 | 100120 | 100121 | 100122 | 100123 | 100124 | 100125 | 100126 | 100127 | 100128 | 100129 | 100130 | 100131 | 100132 | 100133 | 100134 | 100135 | 100136 | 100137 | 100138 | 100139 | 100140 | 100141 | 100142 | 100143 | 100144 | 100145 | 100146 | 100147 | 100148 | 100149 | 100150 | 100151 | 100152 | 100153 | 100154 | 100155 | 100156 | 100157 | 100158 | 100159 | 100160 | 100161 | 100162 | 100163 | 100164 | 100165 | 100166 | 100167 | 100168 | 100169 | 100170 | 100171 | 100172 | 100173 | 100174 | 100175 | 100176 | 100177 | 100178 | 100179 | 100180 | 100181 | 100182 | 100183 | 100184 | 100185 | 100186 | 100187 | 100188 | 100189 | 100190 | 100191 | 100192 | 100193 | 100194 | 100195 | 100196 | 100197 | 100198 | 100199 | 100200 | 100201 | 100202 | 100203 | 100204 | 100205 | 100206 | 100207 | 100208 | 100209 | 100210 | 100211 | 100212 | 100213 | 100214 | 100215 | 100216 | 100217 | 100218 | 100219 | 100220 | 100221 | 100222 | 100223 | 100224 | 100225 | 100226 | 100227 | 100228 | 100229 | 100230 | 100231 | 100232 | 100233 | 100234 | 100235 | 100236 | 100237 | 100238 | 100239 | 100240 | 100241 | 100242 | 100243 | 100244 | 100245 | 100246 | 100247 | 100248 | 100249 | 100250 | 100251 | 100252 | 100253 | 100254 | 100255 | 100256 | 100257 | 100258 | 100259 | 100260 | 100261 | 100262 | 100263 | 100264 | 100265 | 100266 | 100267 | 100268 | 100269 | 100270 | 100271 | 100272 | 100273 | 100274 | 100275 | 100276 | 100277 | 100278 | 100279 | 100280 | 100281 | 100282 | 100283 | 100284 | 100285 | 100286 | 100287 | 100288 | 100289 | 100290 | 100291 | 100292 | 100293 | 100294 | 100295 | 100296 | 100297 | 100298 | 100299 | 100300 | 100301 | 100302 | 100303 | 100304 | 100305 | 100306 | 100307 | 100308 | 100309 | 100310 | 100311 | 100312 | 100313 | 100314 | 100315 | 100316 | 100317 | 100318 | 100319 | 100320 | 100321 | 100322 | 100323 | 100324 | 100325 | 100326 | 100327 | 100328 | 100329 | 100330 | 100331 | 100332 | 100333 | 100334 | 100335 | 100336 | 100337 | 100338 | 100339 | 100340 | 100341 | 100342 | 100343 | 100344 | 100345 | 100346 | 100347 | 100348 | 100349 | 100350 | 100351 | 100352 | 100353 | 100354 | 100355 | 100356 | 100357 | 100358 | 100359 | 100360 | 100361 | 100362 | 100363 | 100364 | 100365 | 100366 | 100367 | 100368 | 100369 | 100370 | 100371 | 100372 | 100373 | 100374 | 100375 | 100376 | 100377 | 100378 | 100379 | 100380 | 100381 | 100382 | 100383 | 100384 | 100385 | 100386 | 100387 | 100388 | 100389 | 100390 | 100391 | 100392 | 100393 | 100394 | 100395 | 100396 | 100397 | 100398 | 100399 | 100400 | 100401 | 100402 | 100403 | 100404 | 100405 | 100406 | 100407 | 100408 | 100409 | 100410 | 100411 | 100412 | 100413 | 100414 | 100415 | 100416 | 100417 | 100418 | 100419 | 100420 | 100421 | 100422 | 100423 | 100424 | 100425 | 100426 | 100427 | 100428 | 100429 | 100430 | 100431 | 100432 | 100433 | 100434 | 100435 | 100436 | 100437 | 100438 | 100439 | 100440 | 100441 | 100442 | 100443 | 100444 | 100445 | 100446 | 100447 | 100448 | 100449 | 100450 | 100451 | 100452 | 100453 | 100454 | 100455 | 100456 | 100457 | 100458 | 100459 | 100460 | 100461 | 100462 | 100463 | 100464 | 100465 | 100466 | 100467 | 100468 | 100469 | 100470 | 100471 | 100472 | 100473 | 100474 | 100475 | 100476 | 100477 | 100478 | 100479 | 100480 | 100481 | 100482 | 100483 | 100484 | 100485 | 100486 | 100487 | 100488 | 100489 | 100490 | 100491 | 100492 | 100493 | 100494 | 100495 | 100496 | 100497 | 100498 | 100499 | 100500 | 100501 | 100502 | 100503 | 100504 | 100505 | 100506 | 100507 | 100508 | 100509 | 100510 | 100511 | 100512 | 100513 | 100514 | 100515 | 100516 | 100517 | 100518 | 100519 | 100520 | 100521 | 100522 | 100523 | 100524 | 100525 | 100526 | 100527 | 100528 | 100529 | 100530 | 100531 | 100532 | 100533 | 100534 | 100535 | 100536 | 100537 | 100538 | 100539 | 100540 | 100541 | 100542 | 100543 | 100544 | 100545 | 100546 | 100547 | 100548 | 100549 | 100550 | 100551 | 100552 | 100553 | 100554 | 100555 | 100556 | 100557 | 100558 | 100559 | 100560 | 100561 | 100562 | 100563 | 100564 | 100565 | 100566 | 100567 | 100568 | 100569 | 100570 | 100571 | 100572 | 100573 | 100574 | 100575 | 100576 | 100577 | 100578 | 100579 | 100580 | 100581 | 100582 | 100583 | 100584 | 100585 | 100586 | 100587 | 100588 | 100589 | 100590 | 100591 | 100592 | 100593 | 100594 | 100595 | 100596 | 100597 | 100598 | 100599 | 100600 | 100601 | 100602 | 100603 | 100604 | 100605 | 100606 | 100607 | 100608 | 100609 | 100610 | 100611 | 100612 | 100613 | 100614 | 100615 | 100616 | 100617 | 100618 | 100619 | 100620 | 100621 | 100622 | 100623 | 100624 | 100625 | 100626 | 100627 | 100628 | 100629 | 100630 | 100631 | 100632 | 100633 | 100634 | 100635 | 100636 | 100637 | 100638 | 100639 | 100640 | 100641 | 100642 | 100643 | 100644 | 100645 | 100646 | 100647 | 100648 | 100649 | 100650 | 100651 | 100652 | 100653 | 100654 | 100655 | 100656 | 100657 | 100658 | 100659 | 100660 | 100661 | 100662 | 100663 | 100664 | 100665 | 100666 | 100667 | 100668 | 100669 | 100670 | 100671 | 100672 | 100673 | 100674 | 100675 | 100676 | 100677 | 100678 | 100679 | 100680 | 100681 | 100682 | 100683 | 100684 | 100685 | 100686 | 100687 | 100688 | 100689 | 100690 | 100691 | 100692 | 100693 | 100694 | 100695 | 100696 | 100697 | 100698 | 100699 | 100700 | 100701 | 100702 | 100703 | 100704 | 100705 | 100706 | 100707 | 100708 | 100709 | 100710 | 100711 | 100712 | 100713 | 100714 | 100715 | 100716 | 100717 | 100718 | 100719 | 100720 | 100721 | 100722 | 100723 | 100724 | 100725 | 100726 | 100727 | 100728 | 100729 | 100730 | 100731 | 100732 | 100733 | 100734 | 100735 | 100736 | 100737 | 100738 | 100739 | 100740 | 100741 | 100742 | 100743 | 100744 | 100745 | 100746 | 100747 | 100748 | 100749 | 100750 | 100751 | 100752 | 100753 | 100754 | 100755 | 100756 | 100757 | 100758 | 100759 | 100760 | 100761 | 100762 | 100763 | 100764 | 100765 | 100766 | 100767 | 100768 | 100769 | 100770 | 100771 | 100772 | 100773 | 100774 | 100775 | 100776 | 100777 | 100778 | 100779 | 100780 | 100781 | 100782 | 100783 | 100784 | 100785 | 100786 | 100787 | 100788 | 100789 | 100790 | 100791 | 100792 | 100793 | 100794 | 100795 | 100796 | 100797 | 100798 | 100799 | 100800 | 100801 | 100802 | 100803 | 100804 | 100805 | 100806 | 100807 | 100808 | 100809 | 100810 | 100811 | 100812 | 100813 | 100814 | 100815 | 100816 | 100817 | 100818 | 10

FIG. 12

SES-200 Conversion Project

Cost Availability Matrix



System Hierarchy		High Value		25 : 52%		Main Connect		Data Missing (Count)		Percent of data	
		Move	Status	Done	Waiting	SGV	SGV	Done	Waiting	SGV	SGV
Drive MTU Engines (2)	Reduction gearing (2)	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Kamewa Waterjets (2)	Kamewa Waterjets (2)	●	●	●	●	SGV	SGV	●	●	SGV	SGV
MTU Litt Engines (2)	MTU Litt Engines (2)	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Firemain Pumps (2)	Firemain Pumps (2)	●	●	●	●	SGV	SGV	●	●	CJP	CJP
Halon System	Halon System	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Tanks (Fuel Oil -4, Ballast -6, Lube -1)	Tanks (Fuel Oil -4, Ballast -6, Lube -1)	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Kamewa Hydraulic Powerpacks (2)	Kamewa Hydraulic Powerpacks (2)	●	●	●	●	SGV	SGV	●	●	SGV	SGV
L/P Air Compressors port	L/P Air Compressors port	●	●	●	●	SGV	SGV	●	●	SGV	SGV
L/P Air Compressors starboard	L/P Air Compressors starboard	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Saechesis (6)	Saechesis (6)	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Ship Service Diesel Generators (2)	Ship Service Diesel Generators (2)	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Electrical Wiring	Electrical Wiring	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Switchboard/Generator Control Panel	Switchboard/Generator Control Panel	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Hull (Steel Plating, Stringers, Frames, Outlets, drydock clean/paint, etc.)	Weather Deck	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Water Tight Doors, (W/T/D's)	Water Tight Doors, (W/T/D's)	●	●	●	●	SGV	SGV	●	●	SGV	SGV
Heads (latrines, 4, sinks, piping, etc.)	Heads (latrines, 4, sinks, piping, etc.)	●	●	●	●	SGV	SGV	●	●	SGV	SGV

- = Data not required
- = Data Collected
- = Need more information to proceed
- █ = Able to look for Reman costs
- █ = In the process of getting cost information
- █ = Need the Removal Cost
- █ = Done

FIG. 13

Option	Recovery	Economic	Notes	Ref
Modify	Impractical	Impractical		
Remove	Impractical	Impractical		
Replace	Possible	Possible		1
Restore	Best	Best		2
Reuse	Impractical	Impractical		

FIG. 14A

Option	Recovery	Economic	Notes	Ref
Modify	Impractical	Impractical		
Remove	Impractical	Impractical		
Replace	Best	Best	Dependent on recovery option for main drive MTU	226
Restore	Possible	Possible		270
Reuse	Impractical	Impractical		

FIG. 14B

Scenario #1: REPLACE MTU engine	REQUIRES	REPLACE Kim Hotstart w/ internal unit
Scenario #2: RESTORE MTU engine		REPLACE Kim Hotstart w/ new unit
Scenario #3: RESTORE MTU engine		RESTORE Kim Hotstart

FIG. 14C

Pair Comparison Matrix					
Determining Weights for Value Analysis					
Decision				Total	% (Weight)
Cost (A)	A vs. B				
Life Expectancy (B)	B vs. C				
Improved Performance (C)	C vs. D				
Operation Cost (Consumables) (D)	D vs. E				
Maintenance Cost (E)	E vs. F				
Overall Environmental Performance (F)	F vs. A				
				Total	100%

FIG. 15

Paired Comparison Matrix					
Determining Weights for Value Analysis					
Decision				Total	% (Weight)
Cost (A)	B	C	A	A	A
Life Expectancy (B)	B	B	B	B	
Improved Performance (C)	C	C	C		
Operation Cost (Consumables) (D)	D	D			
Maintenance Cost (E)	E				
Overall Environmental Performance (F)					
				Total	15
					100%

FIG. 16

Replace Reman Option	% (Weight)	Ratings
Cost (A)	20%	4
Life Expectancy (B)	33%	4
Improved Performance (C)	27%	4
Operation Cost (Consumables) (D)	13%	3
Maintenance Cost (E)	7%	4
Additional Env. Performance (F)	0%	3

FIG. 17A

Restore Reman Option	% (Weight)	Ratings
Cost (A)	20%	3
Life Expectancy (B)	33%	4
Improved Performance (C)	27%	3
Operation Cost (Consumables) (D)	13%	3
Maintenance Cost (E)	7%	4
Additional Env. Performance (F)	0%	3

FIG. 17B

Replace Reman Option	% (Weight)	Ratings	Score
Cost (A)	20%	4	0.80
Life Expectancy (B)	33%	4	1.33
Improved Performance (C)	27%	4	1.07
Operation Cost (Consumables) (D)	13%	3	0.40
Maintenance Cost (E)	7%	4	0.27
Additional Env. Performance (F)	0%	3	0.00

Total 3.87

FIG. 18 A

Restore Reman Option	% (Weight)	Ratings	Score
Cost (A)	20%	3	0.60
Life Expectancy (B)	33%	4	1.33
Improved Performance (C)	27%	3	0.80
Operation Cost (Consumables) (D)	13%	3	0.40
Maintenance Cost (E)	7%	4	0.27
Additional Env. Performance (F)	0%	3	0.00

Total 3.40

FIG. 18 B

Paired Comparison Matrix						
Determining Weights for Value Analysis - Main MTU Engine/Kim Hotstart Scenario						
Decision					Total	% (Weight)
Cost (A)	B	C	A	A	A	3
Life Expectancy (B)	B	B	B	B	5	20%
Improved Performance (C)	C	C	C	C	4	33%
Operation Cost (Consumables) (D)		D	D		2	27%
Maintenance Cost (E)			E		1	13%
Additional Env. Performance (F)					0	7%
				Total	15	0%
						100%

FIG. 19

Scenario #1	% (Weight)	Ratings	Score
Cost (A)	20%	3	0.60
Life Expectancy (B)	33%	5	1.67
Improved Performance (C)	27%	4	1.07
Operation Cost (Consumables) (D)	13%	4	0.53
Maintenance Cost (E)	7%	3	0.20
Additional Env. Performance (F)	0%	4	0.00

Total 4.07

FIG. 20 A

Scenario #2	% (Weight)	Ratings	Score
Cost (A)	20%	4	0.80
Life Expectancy (B)	33%	4	1.33
Improved Performance (C)	27%	3	0.80
Operation Cost (Consumables) (D)	13%	3	0.40
Maintenance Cost (E)	7%	3	0.20
Additional Env. Performance (F)	0%	3	0.00

Total 3.53

FIG. 20 B

Scenario #3	% (Weight)	Ratings	Score
Cost (A)	20%	4	0.80
Life Expectancy (B)	33%	4	1.33
Improved Performance (C)	27%	3	0.80
Operation Cost (Consumables) (D)	13%	3	0.40
Maintenance Cost (E)	7%	3	0.20
Additional Env. Performance (F)	0%	3	0.00

Total 3.53

FIG. 20 C

Optimal Remanufacturing Options: SES-200
(by item)

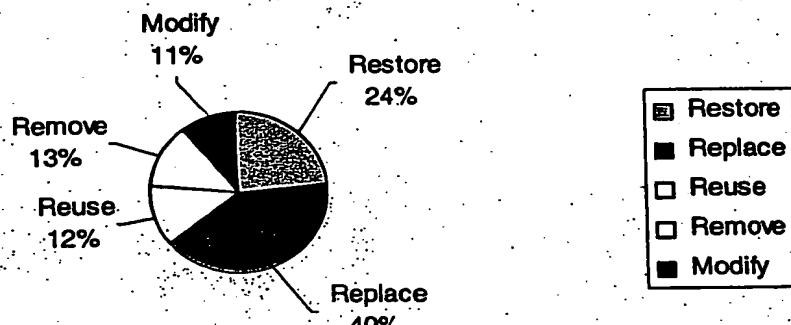


FIG. 21

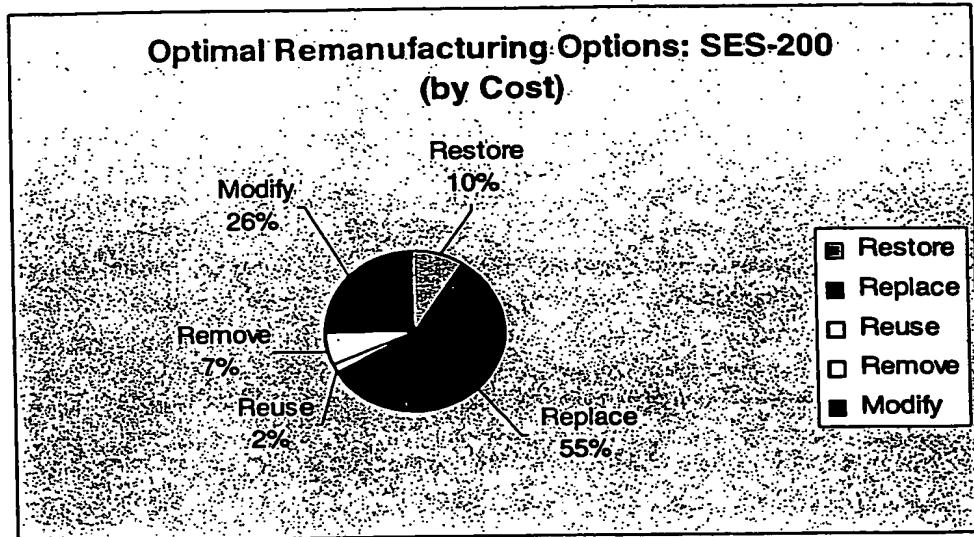


FIG. 22

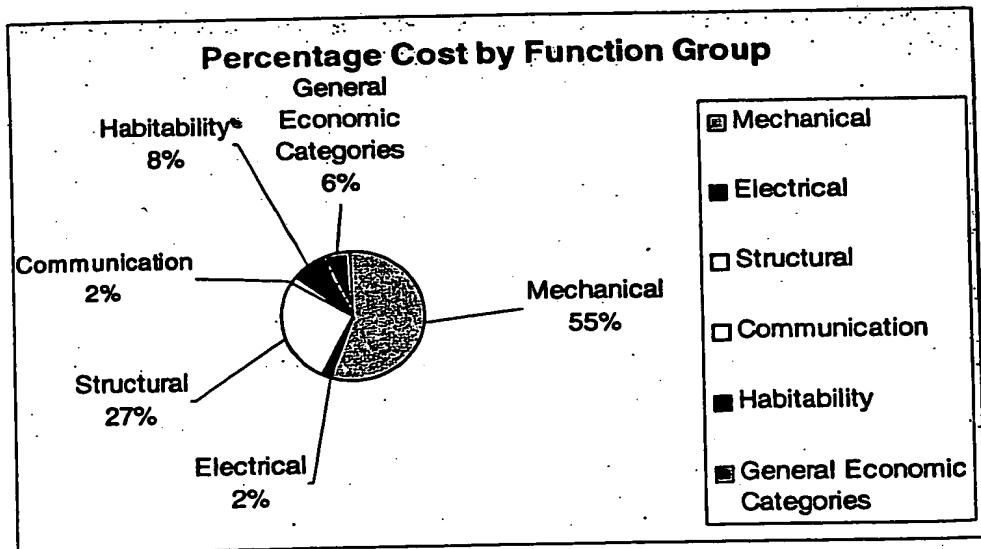


FIG. 23